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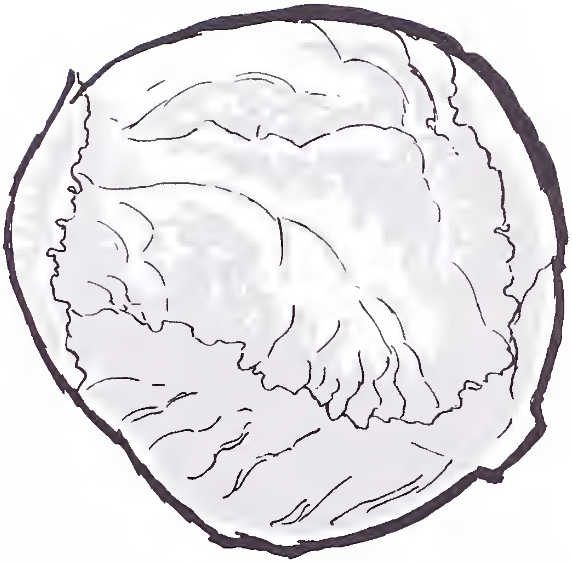
FIELD TRIMMING OF LETTUCE



Effects on Package Weight and Market Quality

Marketing Research Report No. 497

U.S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Market Quality Research Division
in cooperation with
Transportation and Facilities Research Division

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FIELD TRIMMING OF LETTUCE

Effects on Package Weight and Market Quality

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SUMMARY AND CONCLUSIONS

Shipping lettuce at a "firm" rather than "hard" stage of maturity and trimming the heads to fewer wrapper leaves offers a means of reducing package weights without measurable loss of market quality under normal marketing conditions.

Carton weights and market quality were studied in two maturities of lettuce trimmed to 2, 4, 6, and 8 wrapper leaves in the field. Test packages of the trimmed lettuce were shipped from three California districts to the New York market. Indexes of market quality were external appearance, crushing and bruising, decay, tipburn, russet spotting, rib discoloration, and pink rib. Lettuce temperatures were measured before and after vacuum cooling and during transit.

Average weights of cartons of "firm" lettuce were close to 43 pounds when the heads were trimmed to four wrapper leaves, but "hard" lettuce weighed more than 43 pounds even when trimmed to two wrappers.

The average loss in the gross weight of lettuce was 2.4 percent during vacuum cooling and was 0.7 percent during transit. These losses were about the same percentagewise in heads with the various degrees of trimming.

Quality, as indicated by external appearances before and after removing wrapper leaves at the market, was not affected by the field trimming. There were no quality differences due to trimming upon arrival in New York or after holding 5 days at 50° F. However, the net weight of the lettuce after removing the wrapper leaves at the market was slightly less in heads trimmed in the field to two wrapper leaves (32.2 pounds) than in heads trimmed to six wrapper leaves (33.4 pounds), the regular commercial trim. Since the percentage of weight loss during vacuum cooling and in transit was about the same in all the trimmed lots, those trimmed to two wrapper leaves would lose slightly more weight from the marketable portion of the head than those with less trimming. The slight difference in moisture loss in these tests was not enough to affect the external appearance rating, but under more adverse conditions or longer holding, differences in appearance due to trimming might become apparent.

The total weight of defective leaves was slightly less in lettuce previously trimmed to two wrapper leaves (5.3 pounds per carton) than in that trimmed to six wrapper leaves (6.0 pounds), which partially compensated for the lower net weight in the more severely trimmed lettuce after trimming at the market.

Usable lettuce remaining after removing wrapper leaves and leaves with defects at the market was almost the same in heads field trimmed to two wrapper leaves (26.9 pounds per carton) and those trimmed to six wrapper leaves (27.4 pounds). Trimming to two wrapper leaves lowered the gross weight of the package from 52.7 pounds (six wrapper leaves) to 43.6 pounds.

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[2] Agricultural economist, Fresno, Calif.

The average temperature of the lettuce in the test lots after commercial vacuum cooling was 40° F, and on arrival at New York City was 38°. Temperatures should be in the 32° to 35° range for best quality maintenance.

BACKGROUND

The weight of lettuce packed in cartons has increased progressively, largely due to pressure from wholesale buyers and the subsequent selling of lettuce on a weight basis at retail. Aside from the obvious effect of this practice on gross weights of lettuce packages, the effect on quality should be considered. Placing excessive amounts of lettuce in a carton would appear to be a primary cause of bruising and crushing of the heads.

A reduction of package weights might be accomplished by trimming the heads in the field to reduce the number of wrapper leaves remaining in the pack. Five to six wrapper leaves are commonly left on the heads. It has been suggested that decay may be reduced by trimmming, as outer wrapper leaves are contaminated with decay-causing organisms.[3] The fact that they are older chronologically and physiologically makes the wrapper leaves more susceptible to decay than the younger leaves toward the center of the head.

At the request of industry representatives, tests were conducted to relate various degrees of trimming of the heads to package weight, bruising, decay, and other quality factors.

METHODS

Shipping tests were originated in the Salt River Valley of Arizona and the Imperial, Palo Verde (Blythe), and Salinas Valleys of California during the fall of 1958 and the winter, spring, and summer of 1959. Four test shipments were made from each district except from the Salt River Valley, from which only two shipments were made because a heavy frost damaged the lettuce and interfered with eastern shipments. The data from the Arizona tests are not reported because the lettuce was not typical, due to delays in harvesting because of the weather. All shipping tests, except one, were made to the New York marketing area, where test packages were recovered and examined by personnel of the U.S. Department of Agriculture's Market Pathology Laboratory. One car was diverted to the Boston market, but the test packages were recovered and returned to the New York laboratory for examination.

Preparation of Test Packages

Lettuce for the test packages was taken from a limited area in each field, to assure as much uniformity in the samples as possible. Two maturities of lettuce were selected, "hard" and "firm".

The heads were cut by one or two members of the regular field crew, after which they were trimmed by U.S. Department of Agriculture personnel to either 2, 4, 6, or 8 wrapper leaves. The trimmed heads were packed by a member of the regular field crew. Two replicates (cartons) were prepared for each trim of each of the maturities selected, making a total of 16 test packages (24 heads each) per shipping test from each field. A total of 192 test packages was prepared in the three California districts.

Handling of Test Packages

All test packages were weighed before and all, except those in one car, were weighed after vacuum cooling. One car was cooled after loading and the final weights of the packages in this car were estimated on the basis of 1 percent loss in weight for each 10° F. reduction in the temperature of the lettuce. The width of the gap at the closure of the cartons also was measured.

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[3] Parsons, C. S. 1959. Extending the Storage Life of Cabbage, Celery, Lettuce, and Tomatoes Aboard a Navy Supply Ship. U. S. Dept. Agr., Mktg. Res. Rept. 336. 15 pp.

Test packages were cooled with the commercial loads, and were placed in the refrigerator cars in the second and third layers of the load, in two adjacent stacks near the doorway, and in the four center rows of the car.

Transit Temperatures

Continuous temperature records during precooling and in transit were obtained with two Ryan recording thermometers placed in commercial cartons of lettuce that were handled and shipped similarly to the test packages. Temperatures also were taken manually before and after precooling and on arrival at market.

Market Examinations

On arrival at market, each test package was reweighed as soon as possible after removing it from the car. One layer (12 heads) of lettuce in each carton was examined on arrival and the remaining layer was examined after holding for 5 days at 50° F., a simulated marketing period. The layer taken for each examination was selected by design to permit one-half the heads used for each of the variables studied to come from the top layer and the other half from the bottom layer. When the top layer was to be left in the box for the second examination, the carton was opened from the bottom to prevent extra handling of the retained portion of the lettuce.

Condition factors rated and measured at the market were external appearance (with and without wrapper leaves), crushing and bruising, decay, tipburn, russet spotting, rib discoloration, and pink rib. Each head was rated first for external appearance with the wrapper leaves on, since the appearance on arrival is an important factor in marketing. The wrapper leaves were then removed, weighed, and any defects were noted. The trimmed heads were rated for external appearance and were weighed, and the leaves examined for defects.

The total weight of leaves with defects was deducted from the weight of the trimmed head to give the amount of usable lettuce remaining. A leaf may have been rated for more than one disorder, but the discarded leaves were weighed only for the more damaging defect. When condition ratings were similar, the order of priority was decay, tipburn, bruising, russet spotting, rib discoloration, and pink rib. Appearance ratings were made on a scale of 1 to 5 in which 1 was "unsalable" and 5 was "excellent." Condition ratings were on the same scale, but 1 indicated that none of the heads was affected with the particular defect and 5 that the leaves were severely affected (see table 3, footnotes 1 and 2).

Statistical Analysis

An analysis of variance was made on data which appeared to be significantly affected by the factors studied.

RESULTS

Effect of Trimming on Package Weight

Average gross weights of firm and hard lettuce trimmed to 2, 4, 6, and 8 wrapper leaves and packed in 2-dozen-head cartons are shown in figure 1. Each bar in the graph represents an average of 24 cartons (2 replications, 4 test cars, 3 districts).

The progressive removal of wrapper leaves from each head of lettuce in a carton resulted in a reduction in the total package weight of about 5 pounds for each two wrapper leaves removed from firm lettuce and 4 pounds for each two removed from hard lettuce. The degree of trimming had a highly significant effect on package weight. Average gross weights of all lettuce trimmed to 2, 4, 6, and 8 wrapper leaves were 43.6, 48.2, 52.7, and 56.5 pounds per carton, respectively.

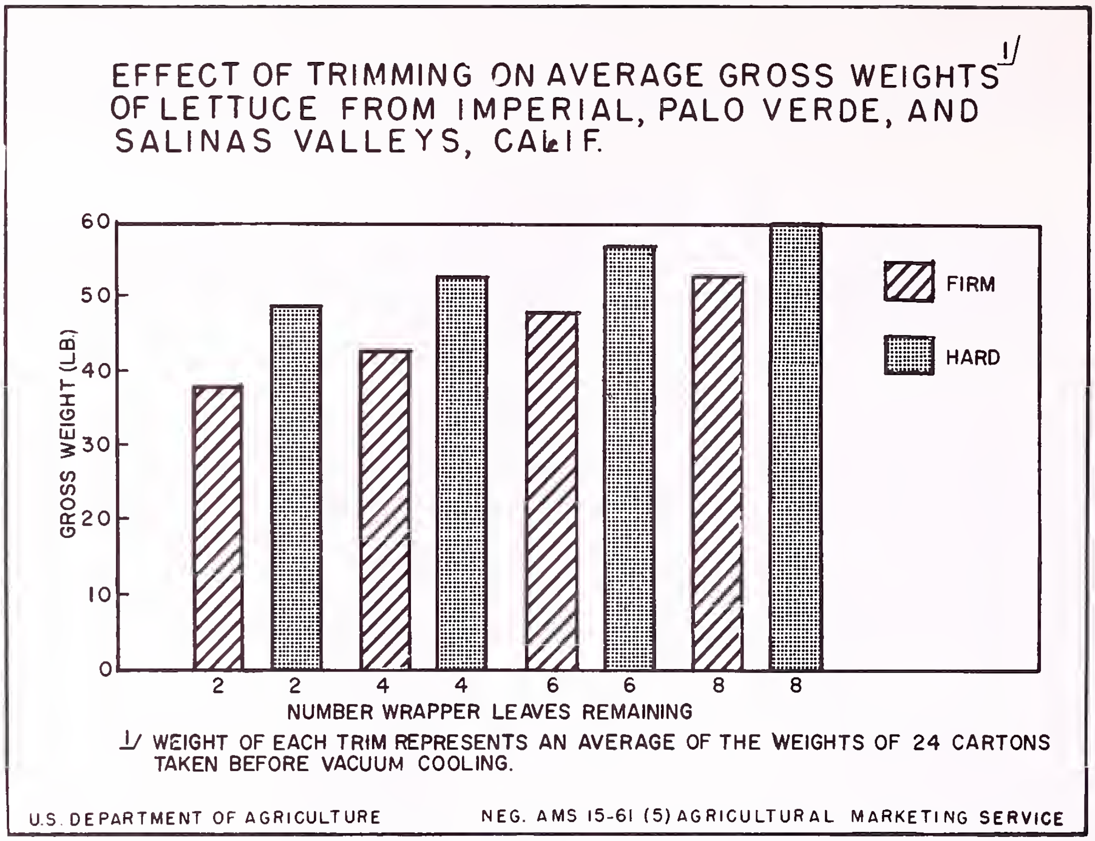

Figure 1

Effect of Maturity on Package Weight

Hard lettuce weighed from 7 to 11 pounds more per carton than firm lettuce with a comparable number of wrapper leaves remaining. The average weight of all the firm lettuce was 45.6 pounds and of all the hard lettuce was 54.8 pounds per carton. Hard lettuce trimmed to two wrapper leaves weighed about the same as firm lettuce trimmed to six wrapper leaves.

Weight Loss During Vacuum Cooling and in Transit

The average loss of weight during vacuum cooling was 2.5 percent in firm lettuce and 2.2 percent in hard lettuce (table 1). During vacuum cooling, moisture is more readily removed from the inner leaves of firm heads of lettuce than from compact, hard heads. Under the conditions of these tests, a carton of lettuce that weighed 50 pounds at harvest would lose from 1.1 to 1.3 pounds during cooling, depending upon the maturity of the heads.

Vacuum cooling studies with lettuce and other commodities show that a 10-degree reduction in temperature is accompanied by a 1 percent loss in weight.[4] In the present tests, the average weight loss during cooling, for lettuce of both maturities from all areas, was 2.4 percent, and the average temperature reduction was 24° F. (table 6), the ratio agreeing with findings in previous work. Lettuce with high initial temperature, therefore, would lose more weight than lettuce that was fairly cool at harvest, assuming that both lots of lettuce were cooled to the same temperature. Lettuce from the Imperial Valley, for example, which was cooled from 57° to 42° F., lost 1.5 percent of its original weight, while warmer lettuce from Blythe, cooled from 65° to 41°, lost 3.0 percent of its weight.

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[4] Barger, W. R. 1961. Factors Affecting Temperature Reduction and Weight Loss in Vacuum-Cooled Lettuce. Mktg. Res. Rept. No. 469, U. S. Dept. Agr.

Weight loss during transit averaged 0.7 percent in firm and 0.6 per cent in hard lettuce.

Trimming appeared to have no consistent effect on weight loss during cooling or in transit.

Relation of Trimming to Carton Closure

The average width of the gap at the closure of the carton was found to increase about one-half inch for each two wrapper leaves left on each head (table 2). An average of all lots indicated that lettuce had to be trimmed to four wrapper leaves to bring the closure to 2 inches. However, in samples taken in the Imperial district, all trims of firm lettuce, and all hard lettuce except the samples with eight wrapper leaves remaining, had closures smaller than 2 inches. In the other two districts, it was necessary to trim to two wrapper leaves in order to bring the closure below 2 inches. The relation between closures and package weights was not consistent (tables 1 and 2). Packages from the Imperial and Blythe districts had about the same average weights, but the average closures were quite different. Packages from the Blythe and Salinas districts had about the same average closures, but had average weights that were quite different.

Effects of Trimming on Market Quality

External appearance.--The external appearance of the lettuce averaged fair to good (3.6) in all lots on arrival at market (table 3). Neither the degree of trimming nor the lettuce maturity affected the external appearance rating at arrival, or after holding 5 days at 50° F. External appearance was slightly poorer (average 3.1) after the holding period than on arrival.

After the wrapper leaves were removed, the heads appeared to be about equal in quality to that previously observed in the respective lots.

Crushing and bruising.--The severity rating for crushing and bruising was slight for each trim and each maturity on arrival (2.8) and after holding (3.1) for the simulated marketing period (table 3). This defect was usually more apparent at the second examination than on arrival (table 4), since the injured tissues became discolored.

The percentage of crushing and bruising (calculated on a weight basis) increased slightly but not significantly with the number of wrapper leaves left on. The average losses from this defect in all lots trimmed to 2, 4, 6, and 8 wrapper leaves were 11.9, 11.7, 12.1, and 13.6 percent, respectively.

Decay.--At arrival, the severity rating for decay was not affected by the trimming or maturity (table 3). The rating was only slightly more severe after 5 days' holding than at arrival (table 4).

The percentage of decayed leaves was slightly greater in hard lettuce than in firm lettuce after the 5-day holding period (table 3), but this relationship was not apparent at arrival. A higher percentage of decayed leaves was consistently found at the second examination than at the first, but this effect was not related to the degree of trimming.

Tipburn.--The degree of trimming or the maturity of the lettuce did not affect tipburn. The average rating for this defect was 1.1 on arrival for both firm and hard lettuce. The percentage of leaves affected with tipburn on arrival was also about the same for firm lettuce (average 0.5 percent) and hard lettuce (average 0.6 percent).

After the simulated marketing period, the severity rating for tipburn was 1.3 in firm lettuce and 1.4 in hard lettuce. The percentage of leaves affected with tipburn averaged 1.8 percent in firm and 2.0 percent in hard lettuce following the holding period. The slight increase was not significant and was apparent only in one test shipment from the Imperial district (table 4). Increases were negligible in other tests.

Russet spotting.--Trimming to different numbers of wrapper leaves had no consistent effect on the severity rating or percentage of leaves with russet spotting (table 3). Slightly more leaves were affected with russet spotting in hard lettuce (average 1.8 percent) than in firm lettuce (average 1.5 percent), which confirmed Rood's findings.[5]

During the 5-day holding period, the percentage of leaves affected with russet spotting in firm lettuce increased from an average of 0.7 percent on arrival to 2.4 percent. The increase in hard lettuce was from 0.6 percent on arrival to 3.1 percent after holding--greater than a five-fold increase.

Rib discoloration.--Rib discoloration was not affected by the degree of trimming or by the holding period (table 4). Hard lettuce had slightly more leaves with this defect (average 1.7 percent) than firm lettuce (average 1.4 percent). It was more severe in the test lots obtained in the Palo Verde Valley than in the other districts (table 4).

Pink rib.--The amount of pink rib found in the test lots was negligible. Firm lettuce had none and hard lettuce had only a few affected leaves.

Usable lettuce remaining.--The amounts of usable lettuce remaining after trimming and removing leaves affected with the defects named are shown in table 5. Lettuce trimmed to eight wrapper leaves had 18.8 percent total defects (6.4 pounds per carton). Lettuce with four and six wrapper leaves had significantly fewer defects--17.4 and 17.6 percent (5.7 and 5.9 pounds carton). Lettuce with two wrapper leaves had 16.5 percent total defects (5.3 pounds per carton), which was significantly less than the amounts in the other lettuce. Total defects were not affected significantly by maturity of the lettuce.

The weight of wrapper leaves trimmed off at the market was 7.0, 11.0, 14.5, and 17.4 pounds per carton, respectively, in lettuce that previously was trimmed to 2, 4, 6, and 8 wrapper leaves in the field.

Usable lettuce remaining after removing the wrapper leaves and leaves with defects at the market was about the same (26.9 to 27.8 pounds) in heads previously trimmed to the various numbers of wrapper leaves (table 5).

Temperatures of Lettuce During Handling and in Transit

Temperatures before precooling, after precooling, and on arrival, and averages in transit for lettuce from the three California districts are shown in table 6. Average temperatures of lettuce after precooling were slightly above 40° F. in the two desert districts, with temperatures in individual tests as high as 46°. The warmer lettuce loads cooled slightly in transit, but average transit temperatures reflected the high initial ones. Temperatures of the test lots of lettuce shipped from the Salinas district were generally below 40° following vacuum cooling.

Quality of lettuce is maintained best at 32° F.[6] Lettuce should be precooled to at least 35° and transit temperatures should be maintained in the 32° to 35° range.

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[5] Rood, Paul. 1956. Relation of Ethylene and Post-Harvest Temperature to Brown Spot of Lettuce. Proc. Amer. Soc. Hort. Sci. 68:296-303.

[6] Wright, R. C., Rose, Dean H., and Whiteman, T. M., 1954. The Commercial Storage of Fruits, Vegetables, and Florists and Nursery Stocks. U. S. Dept. Agr. Handbook No. 66, 77 pp.

TABLE 1.--Weight loss from lettuce during vacuum cooling and during transit from California districts to New York, N. Y., 1959

District	Wrapper leaves remaining	Firm lettuce					Hard lettuce				
		Gross weight before cooling	Gross weight after cooling	Weight loss during cooling	Gross weight on arrival	Weight loss during transit	Gross weight before cooling	Gross weight after cooling	Weight loss during cooling	Gross weight on arrival	Weight loss during transit
	No.	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Pct.*	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Pct.*
Imperial	2	36.4[1]	35.8	1.7	35.3	1.4	46.8	46.0	1.7	45.8	0.4
	4	42.1	41.5	1.4	41.0	1.2	50.7	49.9	1.6	49.6	0.6
	6	47.0	46.3	1.5	45.8	1.1	55.6	54.9	1.3	54.4	0.9
	8	52.0	51.1	1.7	50.6	1.0	60.3	59.6	1.2	59.0	1.0
Palo Verde (Blythe)	2	38.0	36.8	3.2	36.6	0.5	47.4	46.1	2.7	45.9	0.4
	4	42.0	40.7	3.1	40.5	0.5	52.1	50.7	2.7	50.5	0.4
	6	47.2	45.7	3.2	45.4	0.7	56.4	54.8	2.8	54.6	0.4
	8	51.3	49.7	3.1	49.5	0.4	57.4	55.6	2.8	55.6	0.4
Salinas	2	39.4	38.2	3.0	38.1	0.3	49.2	48.0	2.4	47.8	0.4
	4	45.7	44.4	2.8	44.2	0.5	53.2	51.9	2.4	51.6	0.6
	6	50.1	48.7	2.8	48.5	0.4	57.3	56.0	2.3	55.7	0.5
	8	56.5	54.9	2.8	54.6	0.5	59.7	58.4	2.2	58.0	0.7
Average weight loss during cooling				2.5					2.2		
Average weight loss during transit						0.7					0.6

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[1] Average of 8 cartons (2 replications in each of 4 separate test shipments).

TABLE 2.--Closures of lettuce cartons from California districts, 1959 season

District	Date	Wrapper leaves remaining	Carton closure			
			Firm lettuce	Hard lettuce	Average, both maturities	Average, all trims
		No.	*Inches*	*Inches*	*Inches*	*Inches*
Imperial	Jan. 20-23	2	1.1[1]	1.3	1.2	1.6
		4	1.5	1.4	1.5	
		6	1.6	1.7	1.6	
		8	1.8	2.2	2.0	
Palo Verde (Blythe)	Mar. 9-12	2	1.6	2.0	1.8	2.7
		4	2.4	2.3	2.3	
		6	3.0	3.2	3.1	
		8	3.8	3.3	3.5	
Salinas	May 12, Jul. 27-29	2	1.7	2.0	1.8	2.7
		4	2.0	2.7	2.3	
		6	2.5	3.6	3.0	
		8	3.7	3.9	3.8	
Average, all districts		2	1.5	1.8	1.7	2.3
		4	1.9	2.1	2.0	
		6	2.4	2.8	2.6	
		8	3.1	3.1	3.1	

---

[1] Average of 8 cartons (2 replications in each of 4 separate test shipments).

TABLE 3.--Condition of lettuce on arrival and after holding 5 days at 50° F. at New York, N. Y., following shipment from 3 California districts, 1959

Examination	Maturity	Wrapper leaves remaining	External appearance		Crushing and bruising		Decay		Russet spotting		Total defects[2]
			With wrapper leaves	Without wrapper leaves	Severity	Loss by weight[1]	Severity	Loss by weight[1]	Severity	Loss by weight[1]	
		No.	*Rating*[3]	*Rating*[3]	*Rating*[4]	*Pct.*	*Rating*[4]	*Pct.*	*Rating*[4]	*Pct.*	*Pct.*
On arrival	Hard	2	3.6[5]	3.6	2.8	10.4	1.0+	0.1	1.2	0.8	13.9
	Hard	4	3.6	3.6	2.8	11.1	1.0+	0.3	1.1	0.4	13.7
	Hard	6	3.6	3.6	2.7	11.1	1.0+	0.4	1.1	0.4	14.2
	Hard	8	3.6	3.6	2.9	11.8	1.0+	0.1	1.2	0.6	14.6
	Firm	2	3.6	3.7	2.7	11.7	1.0	0.0	1.1	0.6	13.7
	Firm	4	3.6	3.7	2.7	11.8	1.1	1.0	1.1	0.6	15.2
	Firm	6	3.7	3.6	2.7	12.0	1.0+	0.2	1.1	1.0	15.0
	Firm	8	3.7	3.6	2.9	13.8	1.1	0.6	1.1	0.4	17.4
After 5 days at 50° F.	Hard	2	3.0	3.1	3.3	11.9	1.3	2.6	1.4	3.6	20.1
	Hard	4	3.1	3.2	3.1	12.1	1.2	1.0	1.4	2.9	19.8
	Hard	6	3.1	3.1	3.1	11.7	1.3	2.1	1.6	3.5	20.2
	Hard	8	3.1	3.1	3.0	12.3	1.3	2.5	1.4	2.5	21.3
	Firm	2	3.2	3.3	3.1	13.7	1.1	0.7	1.2	1.7	18.5
	Firm	4	3.2	3.2	2.9	11.7	1.2	1.9	1.4	3.3	20.9
	Firm	6	3.2	3.3	3.0	13.5	1.2	0.9	1.3	2.6	20.8
	Firm	8	3.2	3.3	3.2	16.5	1.1	0.8	1.3	1.8	21.8

[1] Calculated on basis of weight of leaves affected and net weight of heads after trimming wrapper leaves.
[2] Includes defects listed plus tipburn, rib discoloration, and pink rib.
[3] 1 - unsalable; 2 - poor; 3 - fair; 4 - good; 5 - excellent.
[4] 1 - none; 2 - trace; 3 - slight; 4 - moderate; 5 - severe.
[5] Average of 24 half-cartons of lettuce (2 replications, 4 test shipments, in 3 districts).

TABLE 4.--Market defects in lettuce from indicated California districts on arrival and after 5 days' holding at 50° F. at New York, N. Y., 1959 season

District and examination	Crushing and bruising		Decay		Tipburn		Russet spotting		Rib discoloration	
	Severity	Loss by weight[1]	Severity	Loss by weight[1]	Severity	Loss by weight[1]	Severity	Loss by weight[1]	Severity	Loss by weight[1]
Imperial										
Arrival.......	*Rating*[1] 2.7[2]	*Pct.* 11.0	*Rating*[1] 1.0	*Pct.* 0.0	*Rating*[1] 1.2	*Pct.* 1.1	*Rating*[1] 1.3	*Pct.* 1.4	*Rating*[1] 1.1	*Pct.* 0.1
After holding.	2.9	10.9	1.2	0.9	1.7	4.7	1.4	1.6	1.1	0.3
Palo Verde (Blythe)										
Arrival.......	2.8	9.2	1.0	0.2	1.0	0.0	1.0	0.1	1.7	3.5
After holding.	3.5	12.6	1.2	1.5	1.0	0.1	1.3	2.9	1.8	3.4
Salinas										
Arrival.......	2.8	14.9	1.1	0.8	1.1	0.5	1.1	0.3	1.2	0.9
After holding.	3.0	15.2	1.3	2.3	1.1	0.7	1.4	3.6	1.2	0.9

[1] See table 3, footnotes 1, 4.
[2] Average of 64 half-cartons of lettuce.

TABLE 5.--Effect of field trimming on average weight, market defects, and amount of usable lettuce following shipment from California to New York, N. Y., 1959 season

Wrapper leaves remaining after field trimming	Average gross weight per carton before vacuum cooling	Average net weight per carton at market		Average weight of trimmed leaves per carton	Percentage total defects[1]	Average weight of defects per carton	Total weight of discarded lettuce per carton	Average weight of usable lettuce per carton
		Before trimming wrapper leaves	After trimming wrapper leaves					
No	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Pct.*	*Lb.*	*Lb.*	*Lb.*
2	43.6[2]	39.2	32.2	7.0	16.5	5.3	12.3	26.9
4	48.2	43.7	32.7	11.0	17.4	5.7	16.7	27.0
6	52.7	47.9	33.4	14.5	17.6	5.9	20.4	27.5
8	56.5	51.6	34.2	17.4	18.8	6.4	23.8	27.8

[1] Includes defects shown in table 3 plus tipburn, rib discoloration, and pink rib. Calculated on basis of weight of leaves affected and net weight of heads after trimming wrapper leaves.

[2] Average of 48 cartons (2 replications, 2 maturities, and 4 test shipments from 3 districts).

TABLE 6.--Temperatures of lettuce shipped from indicated California districts to New York, N. Y., 1959 season

District	Date in 1959	Protective service			Temperatures			
		Icing[1]	Salting		Before precooling	After precooling	On arrival	Average in transit
		Bunkers	Initial	At reicing				
Imperial								
			Pct.	*Pct.*	*°F*	*°F*	*°F*	*°F*
Test 1.........	Jan. 20	Half-stage	None	None	59	46	39	42
Test 2.........	Jan. 21	Mechanical unit[2]			56	40	37	39
Test 3.........	Jan. 22	Half-stage	None	None	54	41	38	41
Test 4.........	Jan. 23	Mechanical unit[2]			58	41	37	39
Average..........					57	42	38	40
Palo Verde (Blythe)								
Test 1.........	Mar. 9	Full	None	None	61	41	37	38
Test 2.........	Mar. 10	Full	None	None	75	45	39	41
Test 3.........	Mar. 11	Full	None	None	69	38	38	39
Test 4.........	Mar. 12	Full	None	None	62	39	36	36
Average..........					67	41	37	39
Salinas								
Test 1.........	May 12	Full	2	2	77	37	39	39
Test 2.........	July 27	Full	2	3	76	40	39	40
Test 3.........	July 28	Mechanical unit[2]			66	37	37	38
Test 4.........	July 29	Full	2	4	61	36	39	38
Average..........					70	37	38	39

[1] Standard refrigeration used in all ice cars.

[2] Thermostat set at 34° F.

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